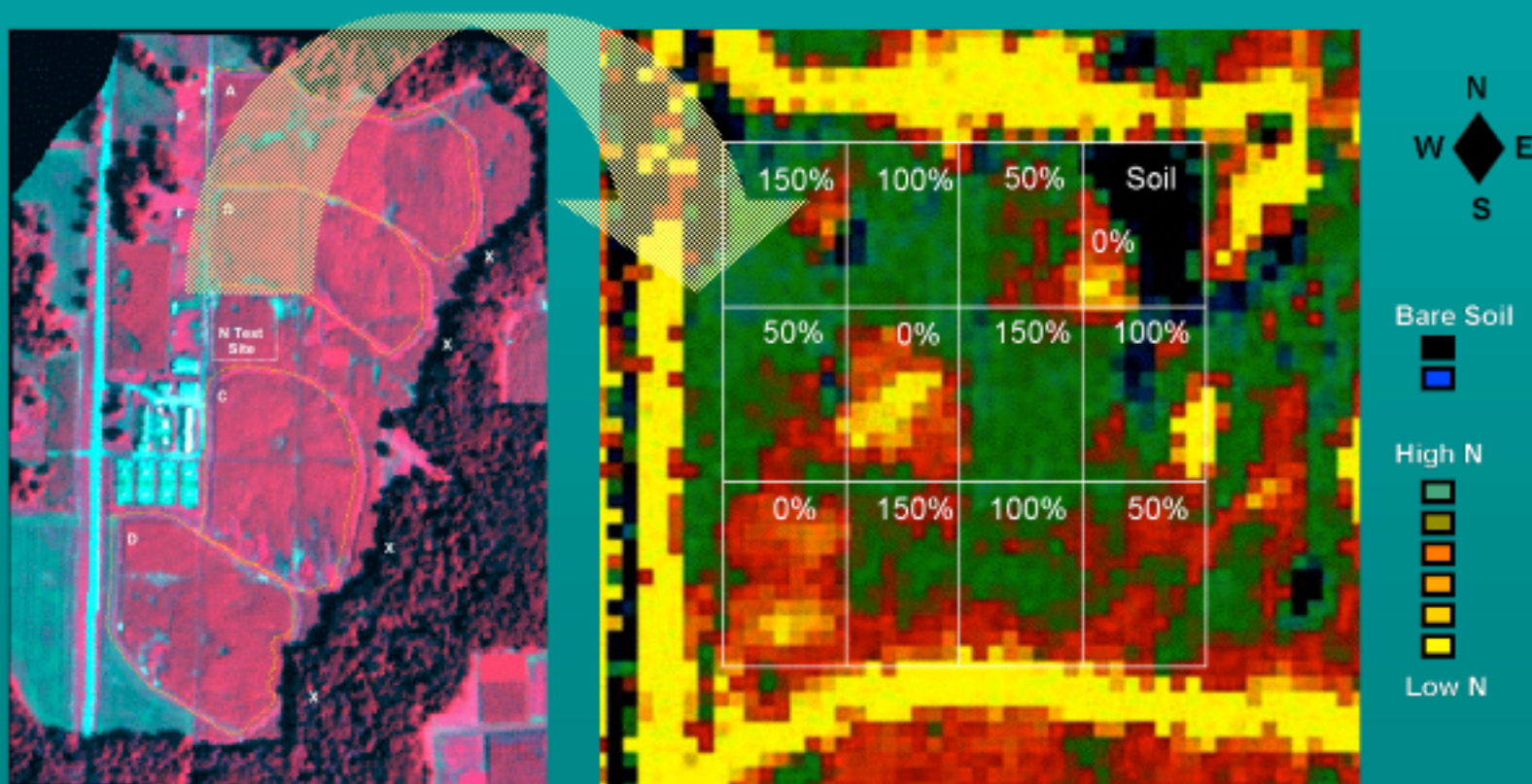




Identification of Nitrogen Stress in Field Corn



Detection of changes in the primary plant pigments chlorophyll *a* and *b* through the modified Chlorophyll Absorption Index (MCARI) can aid in the identification of nitrogen (N) stress in field corn (*Zea Mays* L.)



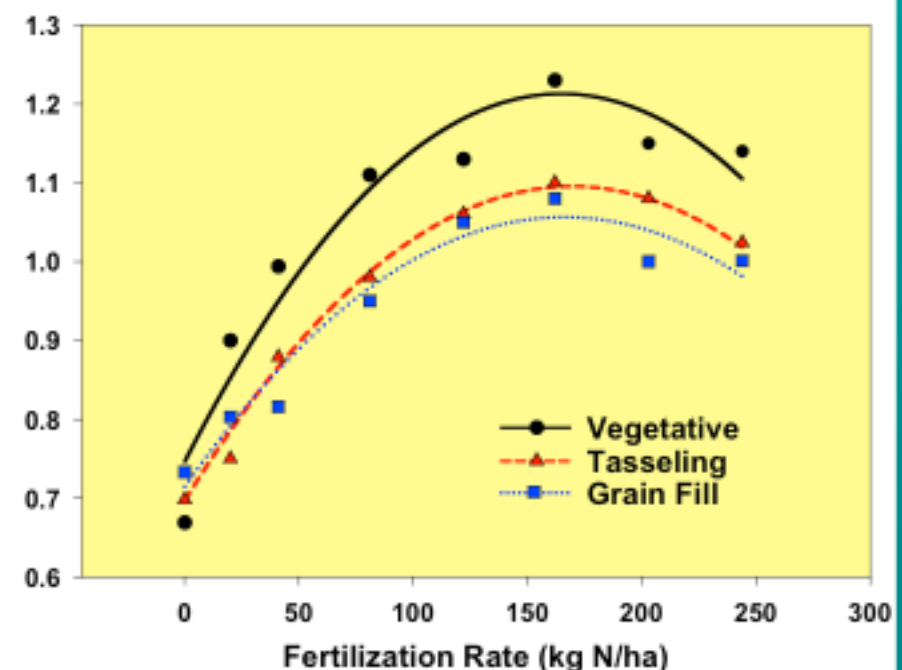
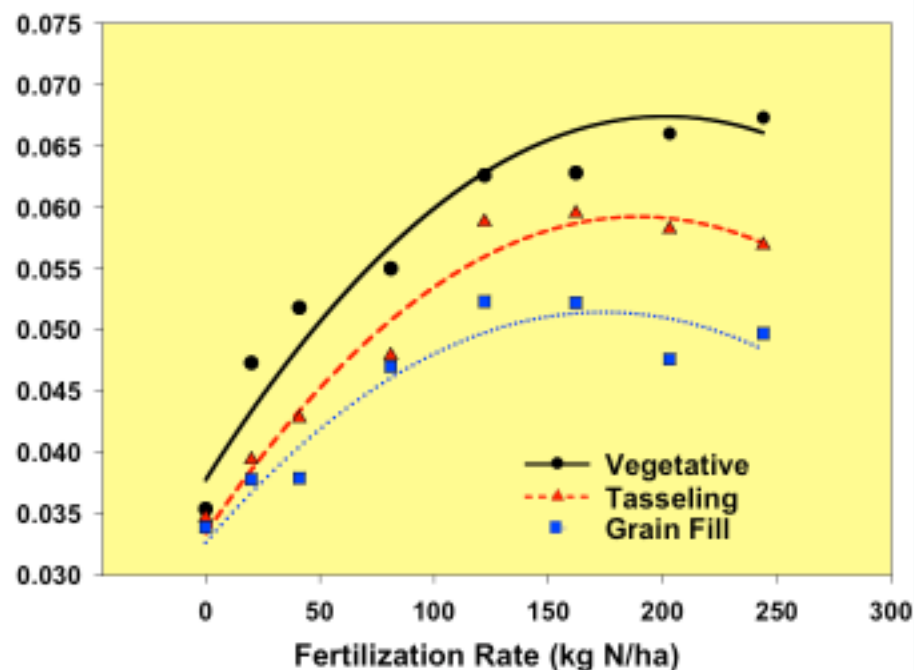
Airborne Imaging Spectrometer for Applications (AISA) 2.5 m ground resolution
E.M. Middleton, NASA/GSFC Code 923 HQ Review 3/17/04



Biophysical Changes in Field Corn due to Nitrogen Supply



The non-linear response of the N:C and far-red/green fluorescence ratio to varying rates of N fertilization peaked at optimal fertilization levels. Both biophysical parameters decreased as the crop progressed through reproductive to grain fill growth stages.





FIS Ratios Relate to Biophysical Parameters in Field Corn



TESTING OF FLUORESCENCE BAND RATIOS

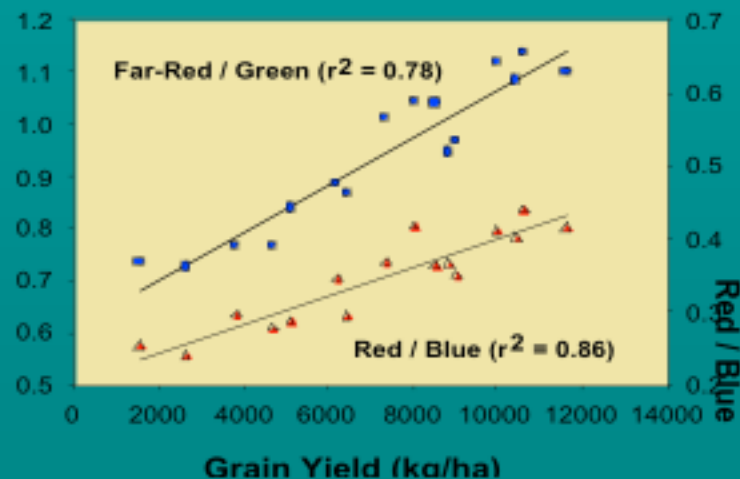
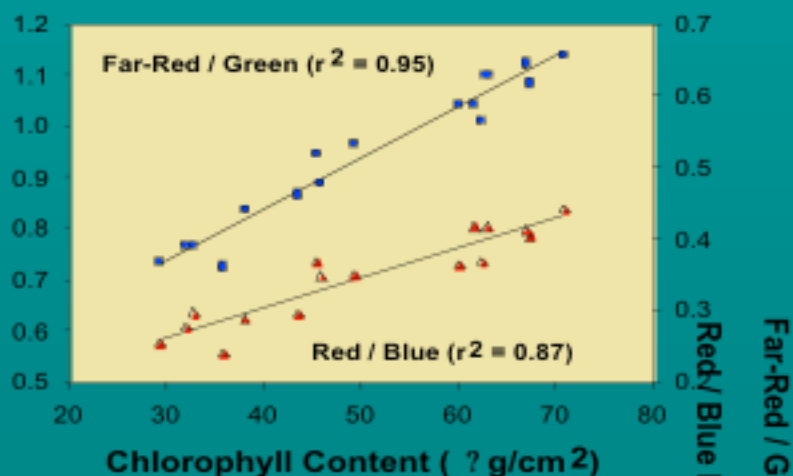
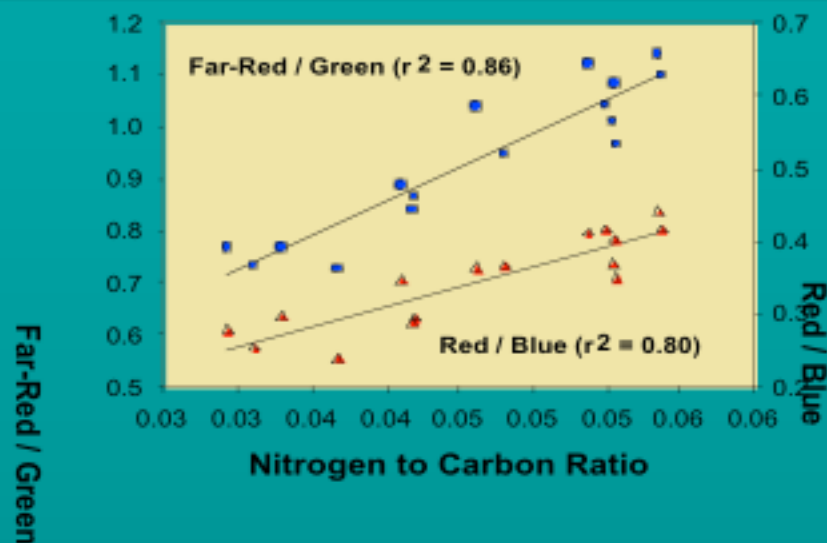
Comparison of linear correlation coefficients (r) of fluorescence imaging band ratios.

Band Ratio	Growth Stage	Total Chlorophyll	N:C	LAI	Yield
Blue / Green	V	0.55**	0.50**	0.52**	ns
	T	0.43*	0.56*	0.52**	0.51**
	G	ns	ns	ns	0.60*
Red / Far-Red	V	0.79**	0.85**	0.73**	0.75**
	T	0.49**	ns	0.63**	0.44*
	G	0.53*	ns	0.71*	0.69**
Red / Blue	V	0.75**	0.82**	0.71**	0.71**
	T	0.73**	0.65**	0.74**	0.62**
	G	0.94**	0.91**	0.80*	0.87**
Red / Green	V	0.89**	0.88**	0.86**	0.72**
	T	0.77**	0.83**	0.87**	0.75**
	G	0.96**	0.94**	0.82*	0.92**
Far-Red / Green	V	0.89**	0.87**	0.86**	0.70**
	T	0.81**	0.87**	0.88**	0.79**
	G	0.73**	0.70*	0.78*	0.81**
Red * Far-Red / Blue * Green	V	0.84**	0.86**	0.81**	0.72**
	T	0.82**	0.82**	0.84**	0.74**
	G	0.87**	0.84**	0.85**	0.90**

Measurement dates V, T, and G correspond to vegetative, tasseling, and grain
Strength of association t-test probability coefficient *=(0.01# p # 0.05), **=(p < 0.01).



Fluorescence Ratios Relate to Biophysical Parameters in Field Corn



Corp, L.A., McMurtrey, J.E., Middleton, E.M., Mulchi, C.L., Chappelle, E.W., Daughtry, C.S.T., "Fluorescence Sensing Systems: *In Vivo* Detection of Biophysical Variations in Field Corn due to Nitrogen Supply", *Remote Sensing of the Environment*, 86:470-479, 2003.



Theme # 2

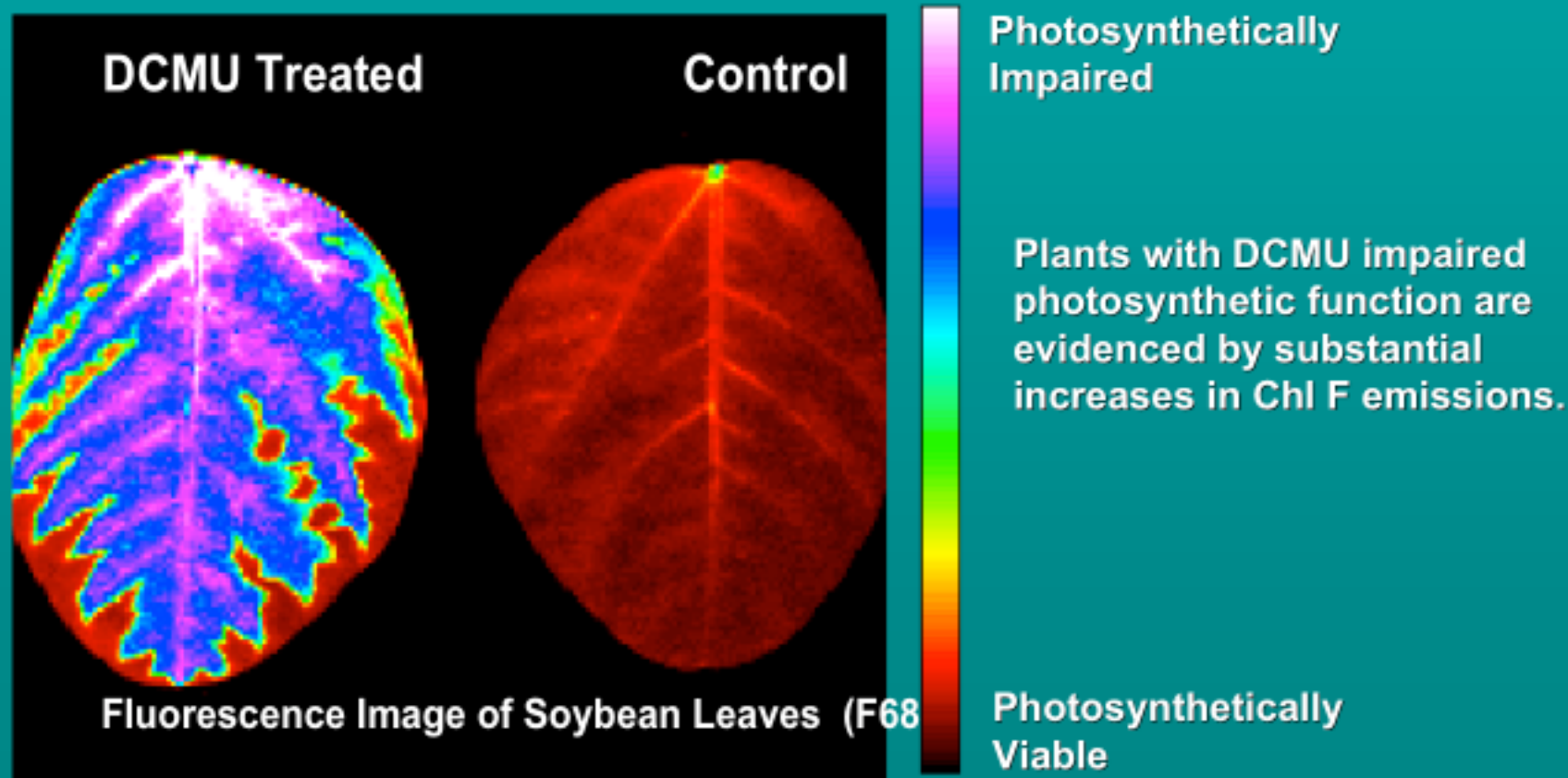
Spectral Indicators of Stress or Environmental Factors



Fluorescence Monitoring of Photosynthetic Function



Chl F changes occur when stress conditions damage the photosynthetic apparatus as well as during temporary photo inhibition serving as a protective or adaptive mechanism. Here, the plant herbicide DCMU is used to inhibit photosynthetic electron transport from PS II to PS I.





Fluorescence Emissions Quantified Over Entire Leaf Surfaces



FIS is being used to quantify fluorescence emissions over plant surfaces under darkened laboratory conditions and relationships are being established between these emission bands and band ratios to biophysical measures of plant growth condition.

Photographic Color Image



Red Maple
Acer rubrum L.

Blue (440 nm)



Red (680 nm)



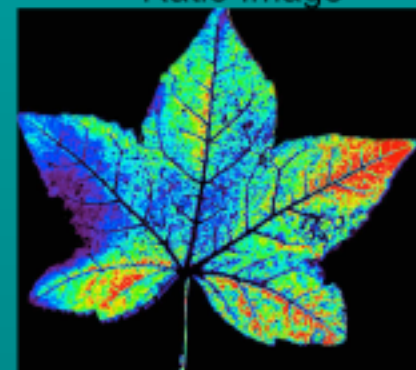
Green (550 nm)



Far-Red (740)



Far-Red/Green
Ratio Image



Low  High

L.M. Butcher, E.M. Middleton, P.K. Entcheva Campbell, L.A. Corp, J.E. McMurtrey, and E.W. Chappelle, "Spectral fluorescence signatures of Tulip poplar, Red maple and Sweet gum under increasing nitrogen fertilization levels", Presented at Ecological Society of America, Annual Meeting 2003.

E.M. Middleton, NASA/GSFC Code 923 HQ Review 3/17/04

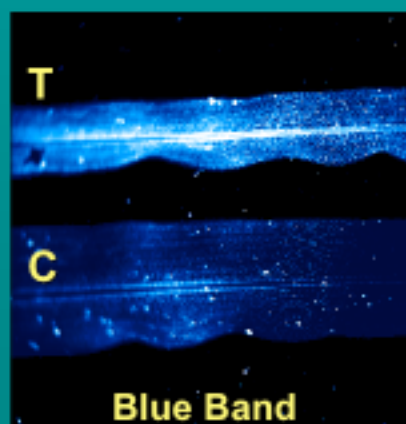
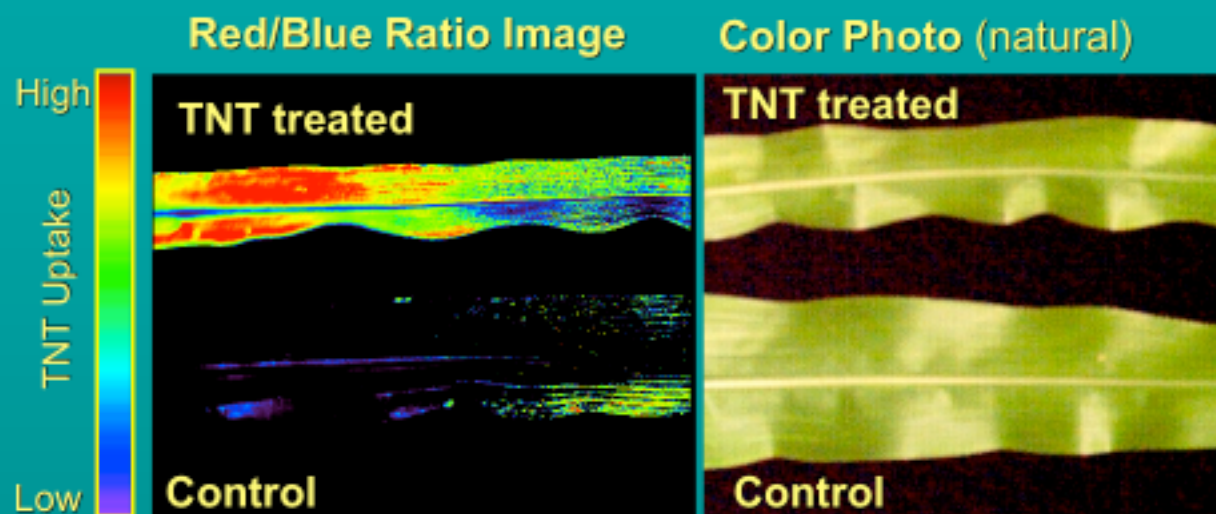


Fluorescence Imaging Illustrating the Effects of TNT Uptake on Corn Foliage

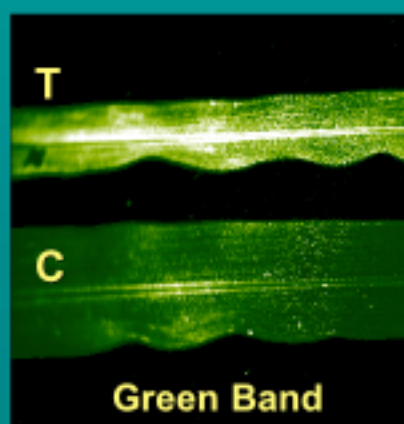


TNT Treatment

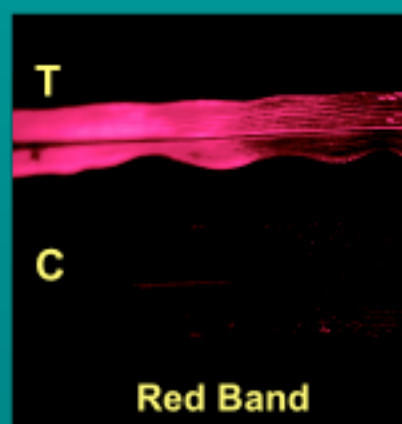
- TNT Concentration: ~80 ppm
- Root Uptake: 7 Applications
- Growth Duration: 72 days



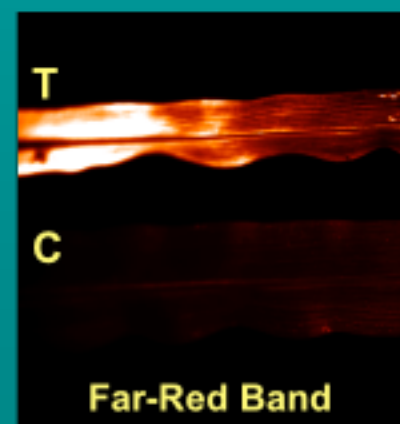
Mean Intensity (dcps)
Control: 117
Treated: 550



Mean Intensity (dcps)
Control: 77
Treated: 314



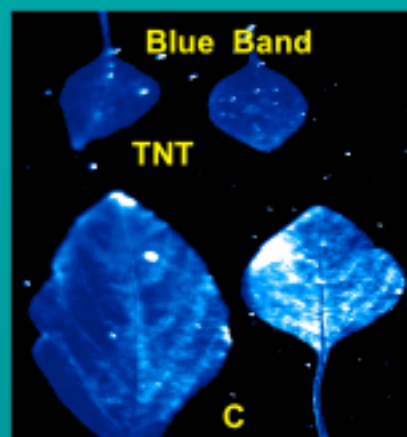
Mean Intensity (dcps)
Control: 58
Treated: 346



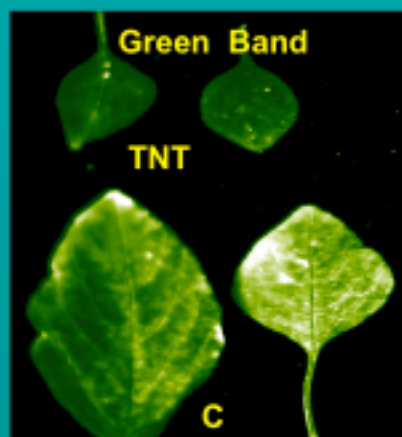
Mean Intensity (dcps)
Control: 964
Treated: 1218



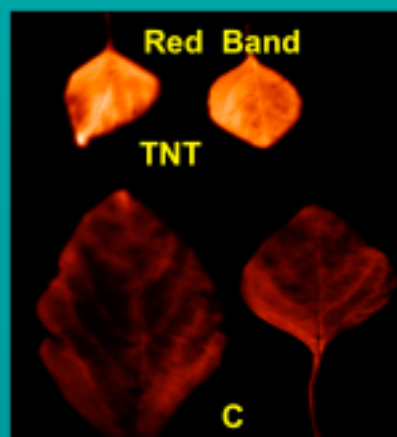
Fluorescence Imaging Illustrating the Effects of TNT Uptake on Pigweed Foliage



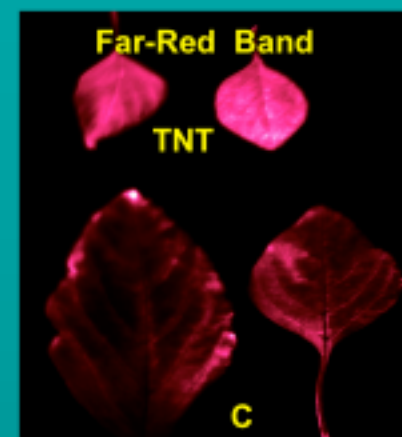
Mean Intensity (dcps)
Treated: 11.1
Control: 21.7



Mean Intensity (dcps)
Treated: 52.3
Control: 165



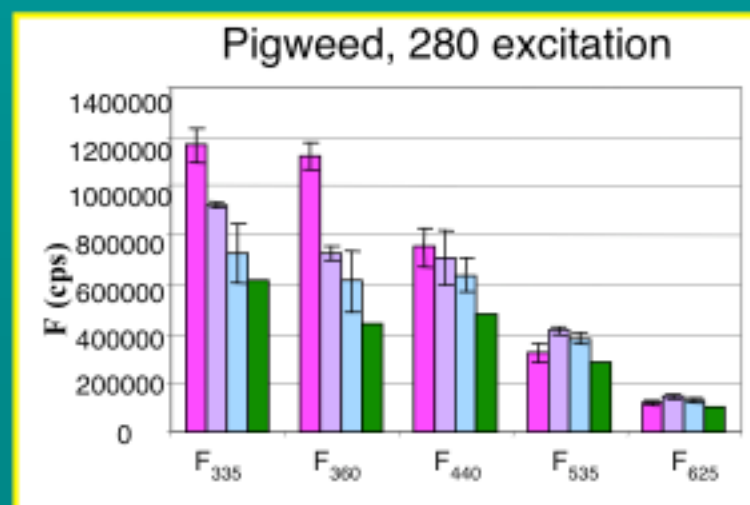
Mean Intensity (dcps)
Treated: 2310
Control: 241



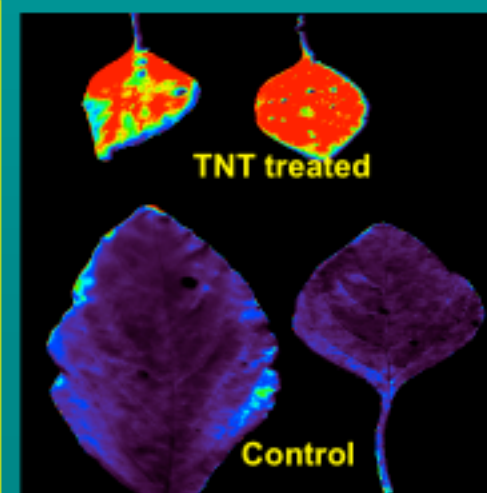
Mean Intensity (dcps)
Treated: 7150
Control: 1226

TNT Treatment

- TNT 50 ppm
- Root Uptake: 7 App.
- Duration: 72 days



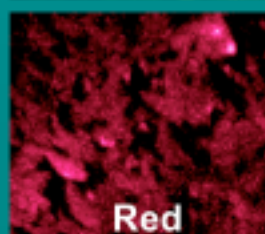
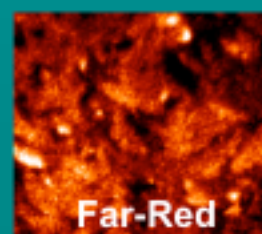
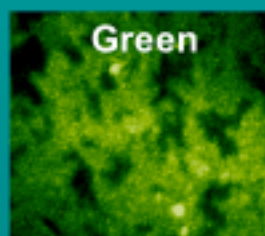
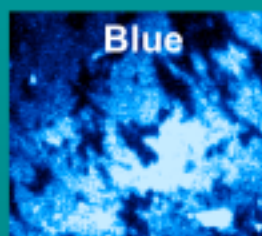
High
Low
Foliar TNT Uptake



Fluorescence Image



LIFIS Images Capture UV Damage in *Acer Rubrum* “Red Maple”



UV-B irradiation induced symptoms of plant physiological stress. Blue and green fluorescence intensities were significantly increased as the result of UV-B exposure, while the red/green fluorescence ratio was significantly reduced in UV-B exposed plants.

Treatment	Blue	Green	Red	Far-red
Control	11.79 b	7.65 b	17.17 a	70.36 a
UV-A	10.52 b	12.64 b	0.42 b	3.62 b
UV- A+B	50.77 a	46.62 a	0.39 b	3.0 b

Means for fluorescence images from UV treated maple trees (color photo above, LIFIS image below). Each mean is based on 10 replicates. Means with the same letter are not significantly different by $LSD_{.05}$ within column comparisons.



Theme # 3

Spectral Indicators Related to Carbon & Nitrogen Dynamics